CLAIMS

1. A flat-plate low-profile actuator, comprising:

a planar conductive polymer layer (3);

an electrode (1) in contact with the conductive polymer layer (3);

an opposite electrode (2) opposite to the electrode (1); and

an electrolyte layer (4) in contact with the conductive polymer layer, disposed in between the electrode (1) and the opposite electrode (2),

the electrode (1) being a planar electrode patterned to have at least one bent portion along a longitudinal direction (5) that is an expansion and contraction direction of the conductive polymer layer so that rigidity in the longitudinal direction is low while rigidity in a width direction almost orthogonal to the longitudinal direction is high, the conductive polymer layer being deformed to be swelled and shrunken by application of electric fields to between both the electrodes.

2. The flat-plate low-profile actuator as defined in Claim 1, wherein the electrode (1) is a zigzag-shaped planar electrode having a plurality of bent portions along the longitudinal direction that is the expansion and contraction direction of the conductive polymer layer.

3. The flat-plate low-profile actuator as defined in Claim 1 or 2, wherein the electrode (1) is a planar electrode comprising: a plurality of band-like portions (1a) along the width direction almost orthogonal to the longitudinal direction that is the expansion and contraction direction of the conductive polymer layer; and link portions (1b) along the longitudinal direction for linking the adjacent band-like portions.

4. The flat-plate low-profile actuator as defined in Claim 1 or 2, further comprising planar extension portions (1c) disposed on both sides of the electrode (1) in the longitudinal direction that is the expansion and contraction direction of the conductive polymer layer, the planar extension portions (1c) being used as force action portions.

5. The flat-plate low-profile actuator as defined in Claim 4, wherein the conductive polymer layer is placed on both front and back surfaces of the electrode (1), and a hole (1d) is provided on the force action portion that is the extension portion of the electrode (1) so as to link the front and back conductive polymer layers for reinforcement.

6. The flat-plate low-profile actuator as defined in Claim 1 or 2, wherein the electrode (1) and the opposite electrode (2) placed on the conductive polymer layer are

stacked in such a way as to be alternately disposed.

7. The flat-plate low-profile actuator as defined in Claim 1 or 2, wherein the electrode (1) is a thin plate made of: metal including gold, platinum, nickel, titanium, and stainless steel; alloy thereof; or carbon, or any one of these thin plates coated with these material groups or subjected to surface treatment such as chemical oxidation.

8. The flat-plate low-profile actuator as defined in Claim 1 or 2, wherein the conductive polymer layer is composed of a pi-conjugated polymer with a substrate of polyaniline, polypyrrole, or polythiophene, any one of organic conductive polymers which are derivatives thereof, or a carbon dispersion conductive polymer.

9. The flat-plate low-profile actuator as defined in Claim 1 or 2, wherein the electrolyte layer is a polymer gel or a polymer containing an ionic liquid.

10. The flat-plate low-profile actuator as defined in Claim 1 or 2, wherein a ratio of a thickness of the conductive polymer layer to a thickness of the electrode is not more than 3.

11. A flat-plate low-profile actuator, comprising:

a planar conductive polymer layer (3);

an electrode (1) in contact with the conductive polymer layer (3);

an opposite electrode (2) opposite to the electrode

(1); and

an electrolyte layer (4) in contact with the conductive polymer layer, disposed in between the electrode (1) and the opposite electrode (2),

the electrode (1) being a planar electrode patterned to have at least one bent portion along an output direction (5) of drive force associated with expansion and contraction of the conductive polymer layer so that rigidity in the output direction is low while rigidity in a direction almost orthogonal to the output direction is high, the conductive polymer layer being deformed to be swelled and shrunken by application of electric fields to between both the electrodes so that the drive force is outputted in the output direction.

12. A manufacturing method for a planar electrode support for a flat-plate low-profile actuator, in which the flat-plate low-profile actuator has an electrolyte layer (4) in contact with a conductive polymer layer (3) disposed in between an electrode (1) having the planar conductive polymer layer (3) attached thereto and an opposite electrode (2) for deforming the conductive polymer layer to be swelled and shrunken by application of electric fields to between both electrodes, and the planar electrode support is composed of the conductive polymer layer and the electrodes, comprising:

patterning a planar electrode as the electrode (1) through etching or punching to have at least one bent portion along a longitudinal direction (5) that is an expansion and contraction direction of the conductive polymer layer so that rigidity in the longitudinal direction is low while rigidity in a width direction almost orthogonal to the longitudinal direction is high; and

in a state that the patterned planar electrode is in contact with another flat plate (20), forming the conductive polymer layer on the electrode (1) by electrolytic polymerization or casting method, and then removing the flat plate to manufacture the planar electrode support.

13. The manufacturing method for a planar electrode support for a flat-plate low-profile actuator as defined in Claim 12, wherein the conductive polymer layer (3d) is further formed, by electrolytic polymerization or casting, on a surface with the flat plate being removed to manufacture the planar electrode support.

14. The manufacturing method for a planar electrode support for a flat-plate low-profile actuator as defined in Claim 12, wherein in a state that the planar electrode to make the electrode (1) is linked to a cutoff portion (1f), which will not remain as the electrode (1), through a cutoff portion link portion (1e), the conductive polymer

layer is formed on the electrode (1) by electrolytic polymerization or casting and then the cutoff portion is removed by cutting at the cutoff portion link portion to manufacture the planar electrode support.

15. The manufacturing method for a planar electrode support for a flat-plate low-profile actuator as defined in Claim 12, wherein the planar electrode to make the electrode (1) is a magnetic substance, and the electrode (1) made of the magnetic substance is brought into contact with the another flat plate (20) through attraction by magnetic force.